

Large Devaluations, Foreign Direct Investment and Exports

A Speculative Note

Daniel Lederman

The World Bank
Development Research Group
Trade and Integration Team
March 2011



Abstract

One side-effect of the Global Financial Crisis of 2008–09 was the resurgence of a debate over exchange rates. The conventional wisdom dictates that real-exchange rate adjustments are needed in order to bring about changes in trade balances across countries. However, the literature on the effect of exchange rate fluctuations and currency under-valuations on exports is surprisingly ambiguous. This note explores for the first time the potential role of foreign direct investment as an intermediate variable in the process of trade adjustment after large real-exchange rate changes. Real-exchange rate devaluations might result in increases in foreign direct investment inflows, as investors can take advantage of changes in the foreign-currency value of domestic assets. If so, the response of exports will depend to some extent on

the nature of such foreign direct investment inflows, with inflows motivated by “horizontal” foreign direct investment associated with negligible changes in export growth after devaluation. The author utilizes quarterly data on real effective exchange rates, foreign direct investment inflows and exports to explore the effects of large devaluations (defined as the largest observed quarterly real effective exchange rate devaluation) on foreign direct investment and exports from 1990 to 2010. The admittedly speculative evidence suggests that there were heterogeneous experiences regarding the timing and magnitude of subsequent changes in foreign direct investment and exports, but on average foreign direct investment inflows tended to precede export surges within two year horizons.

This paper is a product of the Trade and Integration Team, Development Research Group. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The author may be contacted at dlederman@worldbank.org.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

Large Devaluations, Foreign Direct Investment and Exports: A Speculative Note

Daniel Lederman¹

¹ Daniel Lederman is Senior Economist in the Trade and International Integration Unit, Development Research Group (DECTI), World Bank. The author gratefully acknowledges financial support from the World Bank executed Multi-Donor Trust Fund on Trade. Luis Diego Rojas provided stellar research assistance. Benjamin Mandel (FRB) was polite enough to listen to preliminary discussions about the idea underpinning this note. In am grateful to Tatiana Didier (World Bank), Benjamin Mandel, and, especially, Caroline Freund (World Bank) for providing timely and invaluable comments on a previous draft. All remaining errors are the author's responsibility. The views expressed herein do not reflect the opinions of the World Bank, its Board of Director or the countries that they represent.

I. Introduction

One side-effect of the Global Financial Crisis of 2008-09 was the resurgence of a debate over exchange rates, particularly insofar as they are related to the so-called global imbalances and their role in prompting the crisis.² The conventional wisdom is that real-exchange rate adjustments are needed in order to bring about changes in trade balances across countries. However, the literature on the effect of exchange rate fluctuations and currency under-valuations on exports is surprisingly ambiguous about the effect of exchange-rate fluctuations on exports.

Indeed, there are two literatures whose marriage might help shed further light on the effect of exchange-rate fluctuations on exports. One concerns the effect of exchange rates on exports, with some evidence and theories pointing to small or diluted effects of exchange rate changes on exports. The literatures on the pass-through of exchange rate changes into import prices and another on the role of exchange-rate undervaluation on growth provide some relevant insights. However, there is also a literature on “FDI fire sales,” which attempts to explain why inflows of foreign direct investment (FDI) tend to rise even amid currency crises or devaluations. In a sense, this note brings these two strands of the international economics literature together and provides preliminary evidence suggesting that the FDI fire sale effect could be seen as an intermediate mechanism that affects the magnitude of the export surge after real exchange rate adjustments. That is, if FDI increases after devaluations, then the rise of exports might depend to some extent on whether FDI inflows are driven by a desire to establish a footing for multinational corporations to supply the host (domestic) market or for exporting goods or services to other destinations.³

The admittedly speculative empirical exercises discussed in this note began with the identification of episodes of the largest quarterly real exchange-rate devaluations for each country during 1990-2010. In turn, the analysis describes the behavior of FDI inflows and exports two years before and after each devaluation episode, classifying each episode in terms of whether they resulted in abnormally high increases in FDI (e.g., whether the change in FDI was higher than the 75th percentile of the distribution of a country’s observed changes in FDI during the sample period) or abnormally high increases in exports, and whether the surge in FDI occurred before, during or after the export surge. The data cover 60 devaluation episodes, of which 50 percent were characterized by FDI surges that preceded or occurred simultaneously with export surges. Furthermore, regression analysis suggests that the magnitude of devaluations tended to affect the magnitude of the change in FDI, especially among developing countries, which in turn were associated with the magnitude of the change in exports. Hence it appears that increases in FDI are associated with subsequent increases in exports, but devaluations per se do not appear to statistically precede export surges after large devaluations. However, exports do appear to be correlated with subsequent FDI inflows.

The rest of this note is organized as follows. Section II briefly reviews related literatures. Section III covers the data, and the stylized facts concerning the behavior of FDI and exports before and after these large devaluations are presented in Section IV. In turn, section V presents speculative regressions that

² See, for example, Obstfeld and Rogoff (2010), Caballero (2010), and Suominen (2010).

³ In the FDI literature, the former type of FDI has been coined “horizontal” whereas the latter has been described as “vertical,” because it tends to utilize cheaper factors or domestic inputs to assemble exports for other destinations – Carr, Markusen and Maskus (2001) is the seminal article on these topics.

attempt to link changes in REERs, FDI and exports before and after the identified devaluations. Section VI concludes.

II. Related Literatures

This note is related to various literatures. The linchpin is the role of changes in exchange rates in determining both trade flows, especially exports, and FDI. As will become apparent, these literatures are deep, but as far as I know, there are not contributions that focus on both exports and FDI simultaneously.

A. The “Pass Through” Literature

An important literature has focused on the price mechanism that would operate if exchange-rate changes are to have an impact on international trade flows. That is, such changes must have an effect on prices observed by consumers, which then affect consumption choices. However, the literature remains dominated by low pass through estimates. In their literature survey, Goldberg and Knetter (1997) concluded that that a typical estimated elasticity of local goods prices with respect to exchange rate changes is close to one-half in U.S. data, but the elasticity varies across industries. Such a low elasticity relative to the Law of One Price prediction of unity is possibly due to errors in variables, the increasing utilization of imported inputs (intermediate goods) in domestic production, and, more importantly, monopolistic competition and the existence of markups above marginal production costs by firms selling differentiated manufactured goods. Hence Goldberg and Knetter called for further research on the nature of markups, thus linking the macro and trade literatures to the literature on industrial organization on pricing to market behavior. More recent contributions have also found relatively low pass-through from exchange rate changes into local prices, with the low pass through persisting over time (see, for example, Gopinath and Rigobon 2008, and Campa and Goldberg 2005). For our purposes, it suffices to say that exchange-rate devaluations might not yield export surges when firms opt to increase markups through pricing to market.

Notwithstanding the evidence on imperfect pass-through, the existence of fixed costs of exporting can lead to persistent effects of exchange rate devaluations on exports as new exporting firms overcome entry costs in the aftermath of devaluation but the absence of fixed costs of exit imply that firms do not necessarily exit from exporting even after the exchange rate appreciates, thus causing hysteresis in exports. This was the argument of the seminal papers by Baldwin (1988) and Baldwin and Krugman (1989). Dixit (1989) modeled a firm’s decision to become an exporter as a financial option, due to the uncertainty over the value of the exchange rate over time. In his model, firms’ option value of exporting rises with exchange-rate uncertainty. In any case, the key point of this literature was that asymmetric costs of entry into and exit from exporting are likely to be associated with long-lasting effects of devaluations on exports. Evidence from case studies of developing economies reported by Roberts and Tybout (1997) suggested that episodes of export booms were associated with many firms entering export activities while incumbent exporters tended not to increase their exports in response to devaluations. Similarly, Freund and Pierola (2008) analyzed over ninety episodes of manufactured “export surges” and concluded that export surges in developing (but not in developed) economies were associated with large real exchange-rate devaluations that left exchange rate undervalued and with the advent of new export products and

destinations.⁴ Campa (2004) found that export growth associated with hysteresis driven by the extensive margin of trade was small in a sample of Spanish manufacturing firms, which is consistent with Freund and Pierola's finding that persistent devaluations are not associated with export surges in developed economies. New research examining French firms in light of exchange-rate changes suggests that responses can vary across firms, with high-productivity firms or firms that sell high-quality goods tending to raise markups during depreciations while low productivity firms tend to raise their export volumes (Berman, Martin and Meyer 2009). Hence it seems that overall it is difficult to expect huge impacts of exchange rate devaluations on exports, at least for certain types of countries, because the pass through can be attenuated by strategic pricing behavior while the extensive margin effect tends to be small.

B. Currency Under-valuation, Exports and Growth

As mentioned, Freund and Pierola (2008) found that exchange rate devaluations that resulted in significant under-valuation of developing-country currencies were associated with export surges in developing countries, based on an examination of 92 episodes of export surges (instead of episodes of REER adjustments). To some extent, these results might be driven by the research design: the authors first identified the episodes of manufactured exports surges and then explored correlates of the magnitude of the export growth rate, but they did not ask whether the probability of observing an export surge is partially correlated with real exchange rate fluctuations. In contrast, Hausmann, Pritchett and Rodrik (2005) did find that the probability of observing a sustained and large GDP growth episode was associated with real devaluations. Nonetheless, the fact that episodes of sustained devaluations were systematically correlated with both the size of the export surge and the number of new exported products in Freund and Pierola (2008) is an interesting result. As will become apparent, the ongoing shares some methodological aspects with the event-study approach, but our focus is on episodes of large real exchange-rate devaluations and the performance of FDI and total merchandise exports before and after devaluations.⁵

In any case, it is worth mentioning other contributions that examine the link between exchange rates and economic growth. Levy-Yeyati and Sturzenegger (1997) found that an indicator of exchange-rate undervaluation is associated with higher subsequent GDP per capita growth rates, but surprisingly do not argue that this finding works through exports, but rather that it works via capital accumulation. This finding is thus more tightly related to the literature on exchange rates and FDI reviewed below. Rodrik (2008) is perhaps the most complete assessment of the role of under-valued exchange rates in promoting economic growth. The author argued that exports can be hampered by market (coordination) failures, currency under-valuation can provide an impetus to exports and overcome said obstacles, and hence they are associated with faster growth. However, the statistical work presented by Rodrik is far from conclusive regarding the expected link between exchange rate under-valuation and exports as the primary

⁴ Freund and Pierola (2008, p. 3) define an export surge as “a significant and sustained increase in manufacturing export growth from one 7-year period to the next 7-year period.”

⁵ Freund and Pierola (2008) cite Freund (2005) and Hausmann, Pritchett and Rodrik (2005) as pre-existing studies that use the episodes approach. However, event studies have a long tradition in economics – see the literature review by MacKinlay (1997), which cites studies from the 1930s. The latter emphasizes the use of events as a determinant of economic and financial variables. That is, for example, events of news concerning firms can affect firm-specific stock market valuations. In a sense, this approach was meant to identify treatment effects and test whether outcomes before and after were significantly affected by the event or treatment. Our extremely preliminary empirical exercises follow the spirit of this earlier literature.

mechanism linking such policies to subsequent economic growth, relying primarily on the econometric evidence presented in Hausmann, Pritchett and Rodrik (2005).

C. Exchange Rates and FDI

Another literature analyzes the link between exchange rates and FDI. One strand has focused on an empirical regularity, namely that FDI seems to rise during and after severe balance of payments crises. Krugman (2000) was perhaps the first to coin the term “fire-sale FDI” to describe this phenomenon, but several contemporary theoretical and empirical treatments have provided further support to this notion.⁶ Blonigen (1997) advanced our understanding of the link between exchange rates and FDI by proposing a theoretical model in which FDI seeks to acquire “firm-specific” assets, and finds support in data on Japanese acquisitions of U.S. companies during 1975-1992. Aguiar and Gopinath (2005) further pursue the hypothesis that FDI in pursuit of mergers and acquisitions increased during liquidity crises (and devaluations) experienced by East Asia during 1996-1998 and concluded that this effect was particularly prominent in the tradables sector, thus suggesting that FDI might in fact be a stepping stone for the recovery of trade after such crises. World Bank observers have taken this literature seriously, and some have concluded that we can expect an uptick in FDI in the aftermath of the 2008-09 crisis (see, for example, Calderón and Didier 2009).

D. Vertical versus Horizontal FDI

One of the most cited articles in the FDI literature is Carr et al. (2001), which introduced the terms “horizontal” and “vertical” multinational enterprises (MNEs). The former refers to MNEs with foreign affiliates that sell final goods in the host market, whereas vertical MNEs exploit international differences in factor endowments or relative factor costs to export final goods elsewhere. The original motivation for these authors was the emergence of the so-called “new trade theory,” which argued that economies of scale can explain the rise of intra-industry trade during the second half of the twentieth century. They argued that an uncomfortable fact about intra-industry trade was that it was dominated by MNEs. Be that as it may, our interest here is solely due to the contrasting predictions regarding trade flows of the two motivations for FDI: vertical FDI is more likely to result in new international trade flows, especially exports from the host country, whereas horizontal FDI seeks to overcome international trade costs by shifting production and sales into the host country. Hence, if exchange rate devaluations affect FDI, the nature of this new FDI will thus affect the extent to which exchange-rate changes affect exports in a reduced-form model.

III. Data

Quarterly data on REERs, FDI and exports of goods and services come from databases maintained by the International Monetary Fund (IMF). The REER is defined by the IMF as the trade weighted real exchange rate, based on the ratio of indexes of consumer prices between pairs of trading partners.⁷ The series cover

⁶ Krugman’s paper was widely circulated about three years prior to its publication in an edited volume in 2000. However, Blonigen (1997) predated the Krugman’s working paper.

⁷ An alternative index of real exchange rates often used in the literature is the ratio of price indexes found in the Penn World Tables, in which the United States is the benchmark. However, these data are available only in annual frequencies, not quarterly, which might be a significant disadvantage for the empirical analysis in this case. However, it is worth noting that using annual averages of the REER index and the annual data from the Penn World

the period 1990-2010, ending in the third quarter of 2010. The resulting data set covers 60 countries or episodes of large devaluations. An episode of large devaluation was defined as the largest quarter-on-quarter devaluation of each country's REER. These data come from the IMF's information notice system (INS). The value of exports of goods and services and the FDI series come from the IMF's database on International Financial and Trade Statistics.

IV. Stylized Facts

As a first approach to the data, Figures 1 and 2 present the cross-country averages of the REER, FDI and exports variables, normalized so that they equal zero in the quarter of the large devaluation and the units are in country-specific standard deviations. That is, we subtracted the value of each variable in the relevant quarter and divided the resulting series by each country's standard deviation of each variable. This normalization facilitates the interpretation of these graphs.

Figure 1 illustrates that the identification of large devaluations resulted in a discrete change in the level of the REER before and after the identified maximum devaluations. It is noteworthy that on average during the two-year (eight quarters) after each episode the level of the REER was significantly lower than during the preceding two years. That is, the approach yields a significant and persistent devaluation treatment, which hopefully includes devaluations caused by different reasons across the country episodes rather than just reflecting episodes of devaluations driven by financial crises, just the type of unsystematically assigned event suitable for further data analysis. Alternative approaches used in the literature described earlier include the use of proxies for undervaluation or simply examine the effects of exchange-rate variations on other outcome variables. Both would be problematic for an event-study approach.⁸

Figure 2 presents time-period averages of the normalized FDI and exports variables before and after the devaluation episodes, based on data from sub-samples of countries with data for all periods before and after the devaluation, and the list of countries for each sub sample appears in the table in the Appendix.⁹

Tables from 1990-2007, the correlation between the two series is 0.73. Putting the frequency of the data aside, the Penn World Table variable could be more desirable for future work, because the REER depends solely on prices of consumer goods (in each country's basket of goods used to calculate CPI indexes), whereas in principle the PWT index includes consumer goods as well as investment goods and inputs purchased by governments. On the other hand, not all countries in the PWT database conduct price surveys, and the PWT includes observations derived from imputing techniques.

⁸ In addition, the estimation of exchange-rate misalignment is itself a complex undertaking, replete with potential pitfalls, because it requires a well specified model of equilibrium exchange rates. For details, see, for example, Levy-Yeyati and Sturzenegger (2007), Rodrik (2008), among others. Our sample of episodes includes crises that could be driven by sudden stops of capital inflows, such as Mexico's crisis of 1995 and East Asian devaluations during the late 1990s, as well as more recent and less sharp devaluations of high-income country currencies during 2009-2010. Consequently the magnitude of the devaluations vary greatly across countries, but what matters for the FDI fire sale effect is that the devaluations are large relative to the behavior of each country's REER over the longer time horizon of 1990-2010. See section

⁹ Since the date of each episode varies across countries, and some occurred towards the beginning of the sample period or the end, the sample used to calculate these averages changes over the 16 quarters portrayed in the graph. In addition, the coverage of the data for each indicator varies across countries. The series averages with the whole sample paint a different picture. Exports tend to fall immediately prior to the devaluation, bouncing back after the first quarter after the devaluations, and rising steadily thereafter. The FDI series in this sample fall sharply one quarter prior to the devaluation, with a small bounce back that coincides with the quarter of the devaluations,

The trends with constant samples in Figure 2 show that average exports were rising but slowing down prior to the devaluation, but accelerated markedly three quarters after the devaluation. In contrast, the average FDI shows no apparent trend over the period, but it tended to decline for three consecutive quarters prior to the devaluation and recovered with an upswing (the largest in the time 17-quarter time period) one quarter immediately after the devaluation. But this FDI series averages appears to be mean reverting.

On average, it seems that FDI surges after large devaluations, i.e., after t_0 in the graph, anticipate upticks in exports, especially in the constant sample. Readers can easily calculate the standard deviations of the corresponding surges, due to the normalization of the variables. However, the potential existence of trends in the series prior to devaluation (downward in the average FDI prior to devaluation with the whole sample, and upwards in the export series with the constant sample) implies that further econometric exercises need to control for trends in the series in order to assess the correlation between leads and lags of these series. We return to econometric issues in Section V below.

Table 1 summarizes the data around the episodes of large devaluations. It classifies each country experience in terms of the timing and magnitude of the FDI or export surges. The notes at the bottom of the table provide the percentage of the 60 cases that experienced FDI surges – defined as an increase that is above the 75th percentile of the distribution of such changes within countries – prior to export surges and vice versa. The sample is evenly divided into both types of episodes. It is noteworthy, however, that the same exercise but using a lower threshold of the 60th instead of the 75th percentile yielded a higher share of episodes with surges in FDI that was higher than the share of episodes with export surges preceding FDI surges.¹⁰ Hence it seems that there is notable international heterogeneity in terms of the timing of surges, but FDI surges are at least as frequent as export surges. The following section discusses econometric estimates that provide admittedly speculative evidence about whether the correlations between leads and lags of the three variables are partially statistically significant, which can also be interpreted as an assessment of whether the magnitude of REER, FDI and export fluctuations around the time of the large devaluations affected the magnitude of FDI and export surges.

V. Econometric Estimations

How are the stylized facts related to the literatures discussed in section II? Recall that the FDI fire sale effect should imply that devaluations are followed by surges in FDI, which can be transitory, because the literature views this effect as opportunistic behavior by foreign investors waiting for the right moment to buy host-country domestic assets at relatively cheap prices, and this is relative to each country's REER trends. Also, the fire sale effect implies that exports should follow FDI increases in countries where FDI is vertically motivated, but not so much if it is horizontal. Finally, if devaluations have a direct effect on exports by changing the relative prices of exports in importing countries, then exports should follow fluctuations in REERs. These predictions are more likely to be valid after the devaluations, precisely because the fire sale effect would be detected only after the large devaluation and not necessarily before. Hence the models were also estimated with ex-post data only, in which case the estimated effect of the REER on the other two variables will be probably driven by the large devaluation episode and perhaps

followed by a mean reverting process thereafter but with the sharpest surges occurring between the first and third quarters after the devaluation.

¹⁰ These results are available upon request.

attenuated by the less dramatic REER fluctuations that follow the selected large devaluations – see Figure 1 above.

The econometric exercises presented below are perhaps the most speculative portion of this note and rely on the time series processes of each variable. For each variable, the estimations focus on the effect of lagged REER, FDI and exports on FDI and exports. The dynamic versions of the models also include the lagged dependent variable. These dynamic models could be interpreted as Granger causality tests if there were no omitted relevant explanatory variables. Of course, this assumption is hopelessly weak, and hence these exercises remain speculative in nature. However, the specifications do control for country characteristics that did not vary during the 17-quarter period around the episodes of large devaluations, as well as quarter-specific effects that are common across countries for each variable. At best, these are descriptive analyses aiming to identify partial correlations among the three variables of interest.

Tables 2 and 3 present the regression results. The former includes all observations in the data set; the latter uses only observations from developing countries that exclude OECD high-income countries. Both tables follow the same structure: The first two columns correspond to a static and a dynamic model of FDI, followed by the models of exports. The last four columns in both tables show results for the post-devaluation period only. The expectation is that horizontal FDI is more common among high-income economies, and thus the correlation between lagged FDI and exports should be less significant in Table 2, which includes these countries in the estimation sample. Similarly, the ex-post models are expected to show more significant effects of the REER on both variables, because that is the period that follows the deliberately chosen large devaluations (at time $t=0$). Finally, both sets of results were estimated with country fixed effects and quarter-specific effects. The country effects allow us to interpret the results as the effect of deviations from the country mean of the explanatory variable on the dependent variables, which approximate the effect of changes of the explanatory variables.¹¹ The units of the variables are still the normalized variables, and thus readers can easily perform thought experiments about the economic magnitude of the coefficients.

For the whole sample of 60 countries, lagged exports appear with a significant and positive coefficient as determinants of FDI. However, in columns 3 and 4, lagged FDI appears as a significant determinant of exports. Both variables seem to experience a bit of persistence as evidenced by the significance of the lagged dependent variables in each model. Perhaps more importantly, in these models (columns 1-4 in Table 2) the lagged REER is not a significant determinant of either FDI or exports.

Continuing with Table 2, the estimations of the ex-post models presented in columns 5-6 suggest lagged exports continued to be significant as a determinant of subsequent FDI to a larger extent than prior to the devaluation, because the corresponding coefficients are significantly larger than under columns 1 and 2. The lagged REER is now significant and with the expected negative sign (i.e., increases in the REER are appreciations) in the dynamic FDI model (column 6) but not in any other model.

¹¹ Controlling for country fixed effects by de-meaning instead of differences is preferable in this context, because the coefficient on the lagged dependent variable is biased downwards to a lesser extent. The bias is inversely proportional to the number of observations by country, which are close to 17 in this application (i.e., 8 quarters before and after plus the quarter of the large devaluation). In contrast, the bias in the differenced models is not diluted by the number of time periods.

The results for developing countries in Table 3 tell a slightly more robust story. The REER becomes significant and with the expected negative sign in the ex-post models of FDI as expected (columns 5 and 6 of Table 3). In turn, exports appear significantly related to lagged FDI in the static and dynamic models of ex-post exports (columns 7 and 8 in Table 3). The levels of significance are not overwhelming, but this is expected given the low number of countries (38) in this sample. It is worth noting that the magnitude of the lagged REER coefficient in the FDI models tends to be larger in this sample than in the whole sample that includes high-income countries, and the estimated coefficient of lagged FDI on exports tends to be larger and more significant than in the equivalent specifications with the global sample. This is expected, because high-income countries tend to receive higher shares of horizontal FDI than developing countries.

VI. Concluding Remarks

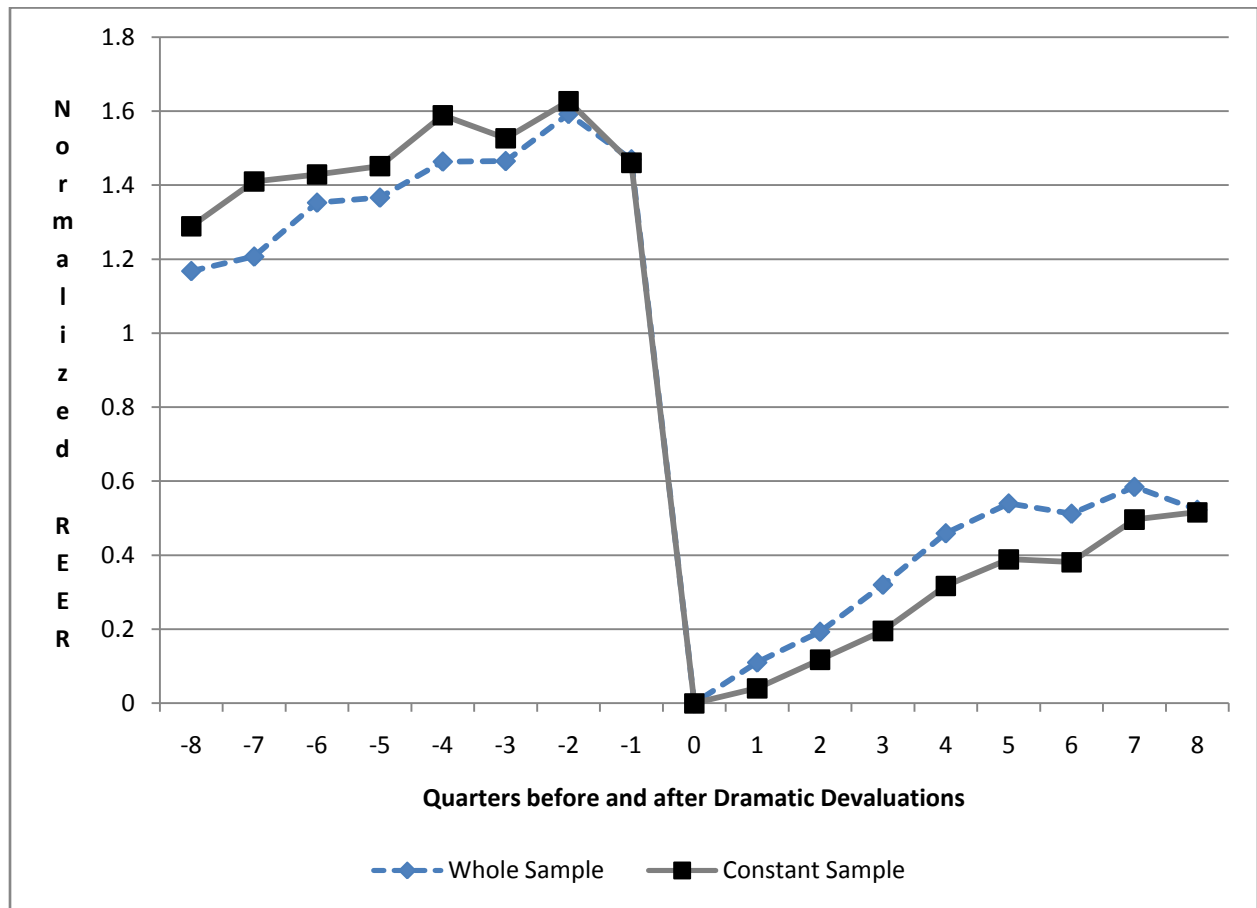
This note started by acknowledging that the interest in the role of exchange rates in determining trade flows has risen in the aftermath of the Global Financial Crisis of 2008-09, and noted that the existing literature includes studies that find small effects of exchange rates on trade flows. In addition, it noted that there is another literature linking exchange rate fluctuations with FDI, with the term “FDI fire sale” often appearing in the literature. This note speculates that the link between exchange rates and exports might be intermediated by the response of FDI, which can be either horizontal or vertical, with the latter tending to raise exports from the receiving countries. Developing countries are thought to receive proportionately more of this type of FDI than rich countries.

The empirical analyses that followed were speculative, but provided a bit of evidence about the behavior of FDI and exports before and after large devaluations, which were defined as the largest quarterly devaluation of the REER for each country. If there is one word that characterizes these episodes, it should be “heterogeneity.” We found an equal number of episodes with FDI surges preceding export surges after large devaluations as the number of episodes with export surges leading FDI.

The simplistic regressions discussed above further highlighted the potential for future research on the relationship between exchange rates, FDI and exports. As expected, the results were weak but more robust in the sample of developing countries, which suggested that REER devaluations tend to raise FDI, and FDI and exports appear to feed on each other. These results probably suffer from omitted variable bias, as the empirical models did not control for much else except country and period fixed effects. Still, future research could pursue more parsimonious econometric strategies to help us identify the effect of exchange rate fluctuations on both FDI and exports. Extending the existing literature on exchange rates and FDI with micro data at the firm level by examining mergers and acquisitions by foreign investors and subsequent exports around episodes of devaluations could also be fruitful.

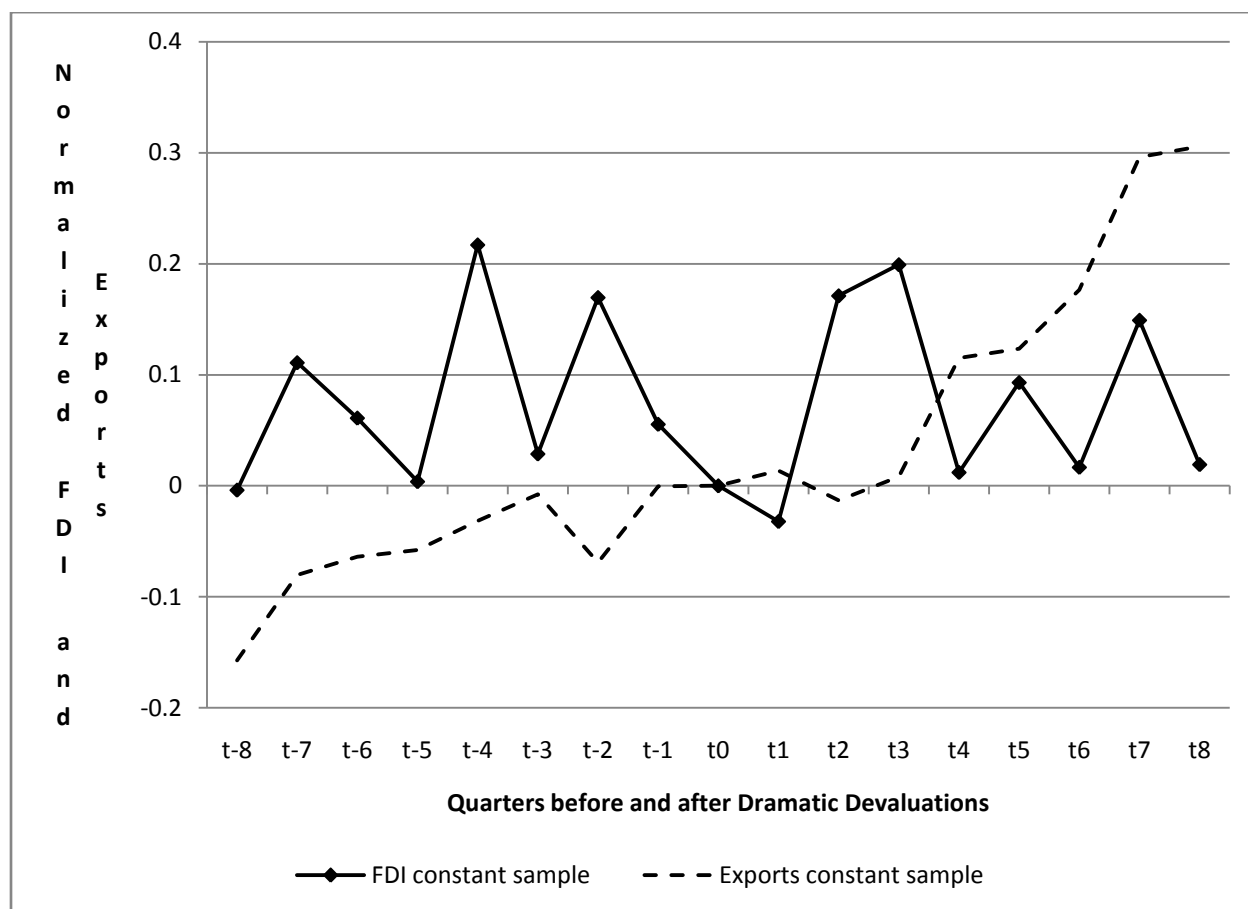
Figures and Tables

Figure 1. Large Devaluations: Average Normalized REER before and after Selected Episodes



Source: Author's calculations based on data from the IMF. See text for details.

Figure 2. FDI and Exports before and after Large Devaluations
(constant sample, see appendix table for list of countries)



Source: Author's calculations based on data from the IMF. See text for details.

Table 1. Episodes of Large Devaluations and the Timing and Magnitude of FDI and Export Surges
(quarterly data, 1990-2010)

	REER Devaluation			Timing of first increase above the 75 centile (quarters after)			Growth rate of first increase above the 75 centile	
<i>Country</i>	<i>Year</i>	<i>Qtr</i>	<i>Growth Rate</i>	<i>Exports</i>	<i>FDI</i>	<i>FDI first?*</i>	<i>Exports</i>	<i>FDI</i>
Argentina	2002	1	-0.54	1	6	C	0.19	0.69
Austria	2010	2	-0.02		0	A		0.61
Bangladesh	1996	3	-0.23	0	3	C	0.23	3.87
Belarus	1999	1	-0.37	1	0	A	0.16	3.04
Belgium	2010	2	-0.03			D		
Bolivia	2009	2	-0.08	4	1	A	0.18	1.56
Brazil	1999	1	-0.33	1	2	C	0.23	0.58
Bulgaria	1996	2	-0.26	3	1	A	1.17	0.80
Canada	2008	4	-0.10	3	2	A	0.08	4.03
Chile	2008	2	-0.10	4	1	A	0.12	2.36
Hong Kong,								
China	1998	4	-0.06	2	6	C	0.15	0.86
Colombia	1999	3	-0.13	0	2	C	0.10	0.43
Costa Rica	2009	2	-0.06	0		C	0.08	
Denmark	1993	3	-0.04	1	3	C	0.11	0.32
Ecuador	1999	1	-0.29	1	3	C	0.12	0.96
Ethiopia	1992	4	-0.54	1		C	0.40	
Fiji	2009	2	-0.19	1	1	B	0.39	0.76
Finland	1993	1	-0.11	3	1	A	0.15	1.19
France	2010	2	-0.04			D		
Georgia	1998	4	-0.13	2	0	A	0.65	1.30
Germany	1991	1	-0.16	3	3	B	0.14	2.72
Guatemala	1990	3	-0.21	2	3	C	0.19	0.48
Hungary	2009	1	-0.11	3	1	A	0.18	11.51
Iceland	2008	4	-0.17	3		C	0.24	
India	1991	3	-0.18	2	0	A	0.17	0.58
Indonesia	1998	1	-0.37	5	0	A	0.15	0.55
Ireland	1993	1	-0.09	1	0	A	0.06	1.90
Israel	2002	2	-0.07	2	3	C	0.08	5.73
Italy	1995	1	-0.09	1	0	A	0.09	1.59
Japan	1995	3	-0.15	7	3	A	0.06	12.44
Jordan	2009	2	-0.04		0	A		2.10
Korea, Rep.	1997	4	-0.34	4	2	A	0.14	1.31
Lithuania	1995	2	-0.08	0	4	C	0.18	0.67
Luxembourg	2010	2	-0.03			D		
Mexico	1995	1	-0.36	0	1	C	0.11	0.47
Mongolia	2009	1	-0.17	1	2	C	0.37	1.73

Nepal	1991	3	-0.12	1		C	0.40	
Netherlands	2010	2	-0.03			D		
New Zealand	2008	4	-0.10	2	4	C	0.15	1.11
Norway	2008	4	-0.12	3	2	A	0.11	15.53
Pakistan	1998	3	-0.13	5	7	C	0.13	1.00
Panama	1998	4	-0.06	4	0	A	0.11	2.31
Papua New Guinea	1999	2	-0.10	0	2	C	0.21	25.96
Philippines	1997	3	-0.14	4	2	A	0.33	1.77
Poland	2008	4	-0.14	3	3	B	0.10	0.72
Portugal	1993	2	-0.03	2	1	A	0.12	1.28
Russian Federation	1998	3	-0.38	5	1	A	0.27	2.11
Singapore	1998	3	-0.05	3	2	A	0.13	16.49
Slovenia	2009	2	-0.16	2		C	0.11	
South Africa	2001	4	-0.22	2	7	C	0.22	3.24
Spain	1993	2	-0.08	0	4	C	0.15	0.59
Sri Lanka	1994	2	-0.07	0	6	C	0.16	4.19
Sweden	1992	4	-0.15	4	5	C	0.13	3.04
Thailand	1997	3	-0.24	7	2	A	0.08	0.89
Turkey	2001	1	-0.27	1	0	A	0.10	2.62
United Kingdom	2008	4	-0.15	2	2	B	0.06	0.83
United States	2009	2	-0.07	2	0	A	0.11	7.58
Uruguay	2002	3	-0.29	3	2	A	0.31	1.26
Vanuatu	1995	2	-0.10	1		C	0.24	
Venezuela								
Rep. Bol.	1994	2	-0.25	0	6	C	0.28	0.62

Source: Author's calculations based on data from the IMF. See text for details.

*Notes: A = The increase in FDI occurred first or there was an increase in FDI but not in Exports: 43.33%

B = The increase in FDI and the increase in Exports occurred in the same quarter: 6.67%

C = The increase in Exports occurred first or there was an increase in Exports but not in FDI: 43.33%

D = There was not an increase in FDI or in Exports: 6.67%

**Table 2. Regression Results: The Magnitude of Devaluations, FDI and Exports
(whole sample)**

VARIABLES	(1) FDI	(2) FDI	(3) Exports	(4) Exports	(5) Ex-post FDI	(6) Ex-post FDI	(7) Ex-post Exports	(8) Ex-post Exports
Lagged FDI		0.169*** (0.0355)	0.0565*** (0.0151)	0.0231* (0.0126)		-0.161*** (0.0512)	0.0461** (0.0224)	0.0337 (0.0216)
Lagged REER	-0.0202 (0.0407)	-0.0130 (0.0403)	0.00721 (0.0172)	-0.0108 (0.0143)	-0.0556 (0.0517)	-0.0861* (0.0520)	0.00336 (0.0234)	-0.00300 (0.0225)
Lagged Exports	0.289*** (0.0864)	0.245*** (0.0860)		0.580*** (0.0297)	0.310*** (0.115)	0.326*** (0.114)		0.274*** (0.0460)
Observations	886	882	901	901	445	445	464	464
R-squared	0.055	0.082	0.129	0.405	0.038	0.063	0.214	0.279
Number of countries	60	60	60	60	60	60	60	60

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

All estimations include period fixed effects and country fixed effects (demeaning approach).

Source: Author's calculations based on data from the IMF. See text for details.

Table 3. Regression Results: The Magnitude of Devaluations, FDI and Exports among Developing Countries

VARIABLES	(1) FDI	(2) FDI	(3) Exports	(4) Exports	(5) Ex-post FDI	(6) Ex-post FDI	(7) Ex-post Exports	(8) Ex-post Exports
Lagged FDI		0.217*** (0.0451)	0.0819*** (0.0208)	0.0295 (0.0183)		-0.0485 (0.0673)	0.0638** (0.0305)	0.0493* (0.0298)
Lagged REER	-0.0280 (0.0413)	-0.0251 (0.0406)	-0.00235 (0.0190)	-0.0261 (0.0164)	-0.100* (0.0595)	-0.105* (0.0599)	-0.0102 (0.0282)	-0.0162 (0.0273)
Lagged Exports	0.274*** (0.105)	0.196* (0.105)		0.540*** (0.0397)	0.210 (0.148)	0.211 (0.148)		0.248*** (0.0593)
Observations	576	572	579	579	306	306	313	313
R-squared	0.048	0.092	0.153	0.375	0.048	0.050	0.188	0.239
Number of countries	38	38	38	38	38	38	38	38

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

All estimations include period fixed effects and country fixed effects (demeaning approach).

Source: Author's calculations based on data from the IMF. See text for details.

Appendix Table: Countries in the Constant Sample of Countries by Indicator

Exports (37 countries)	FDI (33 countries)	REER (36 countries)
argentina	argentina	argentina
bangladesh	bangladesh	bangladesh
belarus	belarus	belarus
brazil	brazil	brazil
bulgaria	bulgaria	bulgaria
chile	chile	chile
china_pr_hong_kong		china_pr_hong_kong
colombia	colombia	colombia
denmark	denmark	denmark
ecuador	ecuador	ecuador
ethiopia	ethiopia	ethiopia
finland	finland	finland
georgia		georgia
indonesia	indonesia	indonesia
ireland	ireland	ireland
israel	israel	israel
italy	italy	italy
japan	japan	japan
korea_republic	korea_republic	korea_republic
lithuania	lithuania	
mexico	mexico	mexico
pakistan	pakistan	pakistan
panama		panama
papua_new_guinea	papua_new_guinea	papua_new_guinea
philippines	philippines	philippines
portugal	portugal	portugal
russian_federation	russian_federation	russian_federation
singapore	singapore	singapore
south_africa	south_africa	south_africa
spain	spain	spain
sri_lanka	sri_lanka	sri_lanka
sweden	sweden	sweden
thailand	thailand	thailand
turkey	turkey	turkey
uruguay	uruguay	uruguay
vanuatu	vanuatu	vanuatu
venezuela_rep_bol		venezuela_rep_bol

References

- Aguiar, Mark and Gita Gopinath. 2005. "Fire-Sale Foreign Direct Investment and Liquidity Crises." *The Review of Economics and Statistics* 87(3): 439-452.
- Baldwin, Richard E. 1988. "Hysteresis in Import Prices: The Beachhead Effect." *American Economic Review* 78: 773-785.
- Baldwin, Richard E., and Paul K. Krugman. 1989. Persistent Trade Effects of Large Exchange Rate Shocks." *The Quarterly Journal of Economics* 104: 635-654.
- Berman, Nicolas, Philippe Martin, and Thierry Mayer. 2009. "How Do Different Exporters React to Exchange Rate Changes? Theory, Empirics and Aggregate Implications." CEPR Discussion Paper No. 7493.
- Blonigen, Bruce A. 1997. "Firm-Specific Assets and the Link between Exchange Rates and Foreign Direct Investment." *American Economic Review* 87(3): 447-65.
- Caballero, Ricardo J. 2010. "Comments on Obstfeld and Rogoff." In *Asia and the Global Financial Crisis*, edited by R. Glick and M.M. Spiegel. San Francisco, CA: Federal Reserve Bank of San Francisco.
- Calderón, César, and Tatiana Didier. 2009. "Will FDI Be Resilient in this Crisis?" LCR Crisis Briefs, Office of the Chief Economist for Latin America and the Caribbean, The World Bank, Washington, DC.
- Campa, José M. 2004. "Exchange Rates and Trade: How Important Is Hysteresis in Trade?" *European Economic Review* 48: 527-48.
- Campa, José, and Linda Goldberg. 2005. "Exchange Rate Pass Through into Import Prices." *The Review of Economics and Statistics* 87: 679-90.
- Carr, David, James R. Markusen, and Keith Maskus. 2001. "Estimating the Knowledge-Capital Model of the Multinational Enterprise." *American Economic Review* 91: 693-708.
- Dixit, Avinash. 1989. "Hysteresis Import Penetration and Exchange-Rate Pass Through." *The Quarterly Journal of Economics* 194: 205-28.
- Freund, Caroline, and Martha Denisse Pierola. 2008. "Export Surges: The Power of a Competitive Currency." World Bank Policy Research Working Paper No. 4750, Washington, DC.
- Freund, Caroline. 2005. "Current Account Adjustment in Industrial Countries." *Journal of International Money and Finance* 24: 1278-98.
- Gopinath, Gita, and Roberto Rigobón. 2008. "Sticky Borders." *Quarterly Journal of Economics* 123(2): 531-75.
- Goldberg, Penelopi K., and Michael M. Knetter. 1997. "Goods Prices and Exchange Rates: What Have We Learned?" *Journal of Economic Literature* 35(3): 1243-72.

Hausmann, Ricardo, Lant Pritchett, and Dani Rodrik. 2005. "Growth Accelerations." *Journal of Economic Growth* 10: 303-29.

Krugman, Paul K. 2000. "Fire-Sale FDI." In *Capital Flows and the Emerging Economies: Theory, Evidence, and Controversies*, edited by S. Edwards. Chicago, IL: The University of Chicago Press, pp. 43-60.

Levy-Yeyati, Eduardo, and Federico Sturzenegger. 2007. "Fear of Appreciation." World Bank Policy Research Working Paper No. 4387, Washington, DC.

MacKinley, A. Craig. 1997. "Event Studies in Economics and Finance." *Journal of Economic Literature* 35: 13-39.

Obstfeld, Maurice, and Kenneth Rogoff. 2010. "Global Imbalances and the Financial Crisis: Products of Common Causes." In *Asia and the Global Financial Crisis*, edited by R. Glick and M.M. Spiegel. San Francisco, CA: Federal Reserve Bank of San Francisco.

Roberts, Mark J., and James R. Tybout. 1997. *What Makes Exports Boom?* Washington, DC: The World Bank.

Rodrik, Dani. 2008. "The Real Exchange Rate and Economic Growth." *Brookings Papers on Economic Activity, Fall*:

Suominen, Kati. 2010. "Did Global Imbalances Cause the Crisis?" VoxEU note no. 5175.